OVERVIEW OF A MEDIUM-VOLTAGE UPS SYSTEM IN A UTILITY SUBSTATION

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- Origin of the Project
- Solution Analysis and Justification
- UPS System Description
- Implementation Overview
- Performance Results

Origin of the Project

- High volume semiconductor wafer FAB operation.
- Concern about loss of “in-process” chips and meeting customer production schedules.
- Number of utility disturbances considered too high.
  - **March through August 1999**
    - Shallow voltage sags (up to 20%)……..3
    - Deep voltage sags (up to 50%)……9
    - Momentary event (greater than 50%)……..1

Solution Analysis and Justification

- Customer facilities engineering under analysis of solution alternatives to mitigate voltage disturbances:
  - Conventional low voltage UPS distributed throughout facility to protect most critical equipment only (approximately 4000 kVA).
  - Solid-State Source Transfer Switch (STS) between two utility feeders at 12.47 kV.
  - Medium voltage UPS (12.5 MVA @ 12.47 kV) to protect entire FAB.

Solution Analysis and Justification

Solution	Events Totally Mitigated	% of Mitigation
Subcycle STS[1]	2 of 13	15%
Low Voltage UPS[2]	9 of 13	69%
Medium Voltage UPS	13 of 13	100%

Comments
1. Utility substation feed by 69 kV loop transmission line. Majority of events transmission related.
2. Low voltage UPS sufficient to protect FAB tools (13 of 13), but production impacted by interaction of unprotected portions of the load.

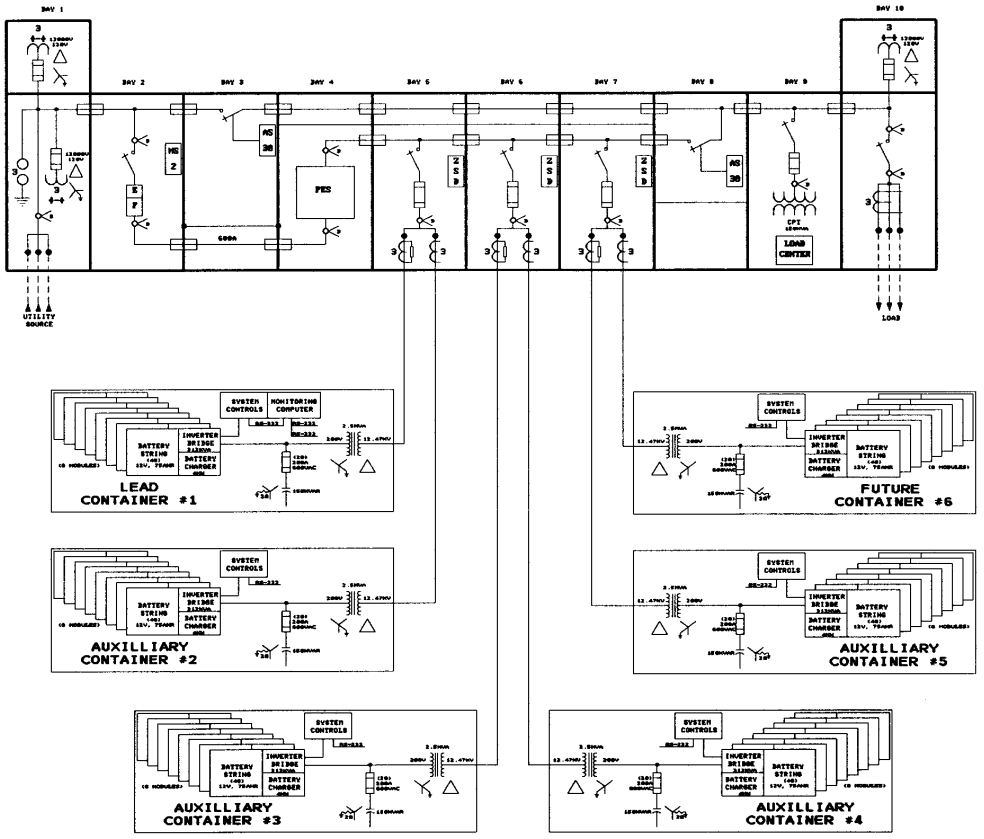
Solution Analysis and Justification

- Medium voltage UPS chosen as most cost effective solution
  - Payback projected to be less than 24 months.
  - No requirement on building space in FAB.
  - Lower overall life cycle cost.
  - Installation of solution had to be “do-able” without a utility service outage.
  - Utility willing to cooperate on medium voltage solution.

UPS System Description

- Actual load profiles analyzed to determine current kVA and kW usage.
- Customer conducted projected load growth study.
- UPS Load Capacity:
  - 10-11 MVA peak in summer
  - 12-13 MVA projected total
- UPS System Rating:
  - Initial Capacity = 12.5 MVA/10.0 MW at 12.47 kV
  - Ultimate Capacity = 15.0 MVA/12.0 MW at 12.47 kV

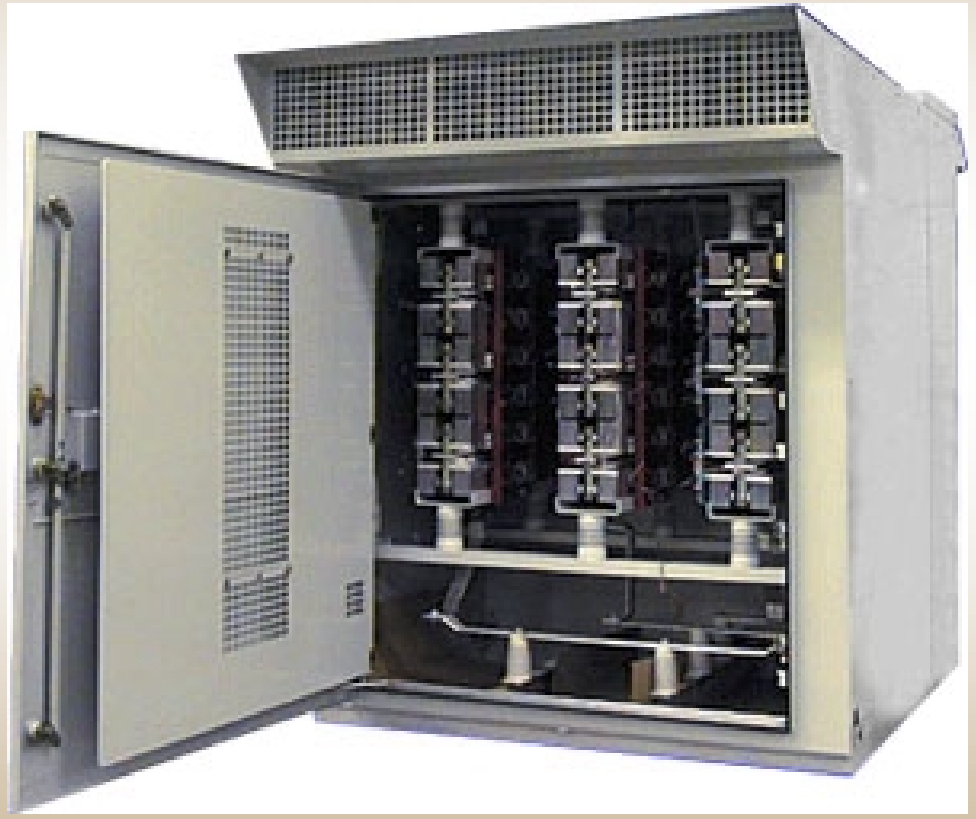
Semiconductor Wafer FAB
Phoenix, AZ



Outdoor 2,500 kVA UPS Container (8 x 313 kVA Power Modules)

313 kVA/250 kW Power Module With 30 Seconds of Battery Storage

Medium Voltage Power Electronic Switch

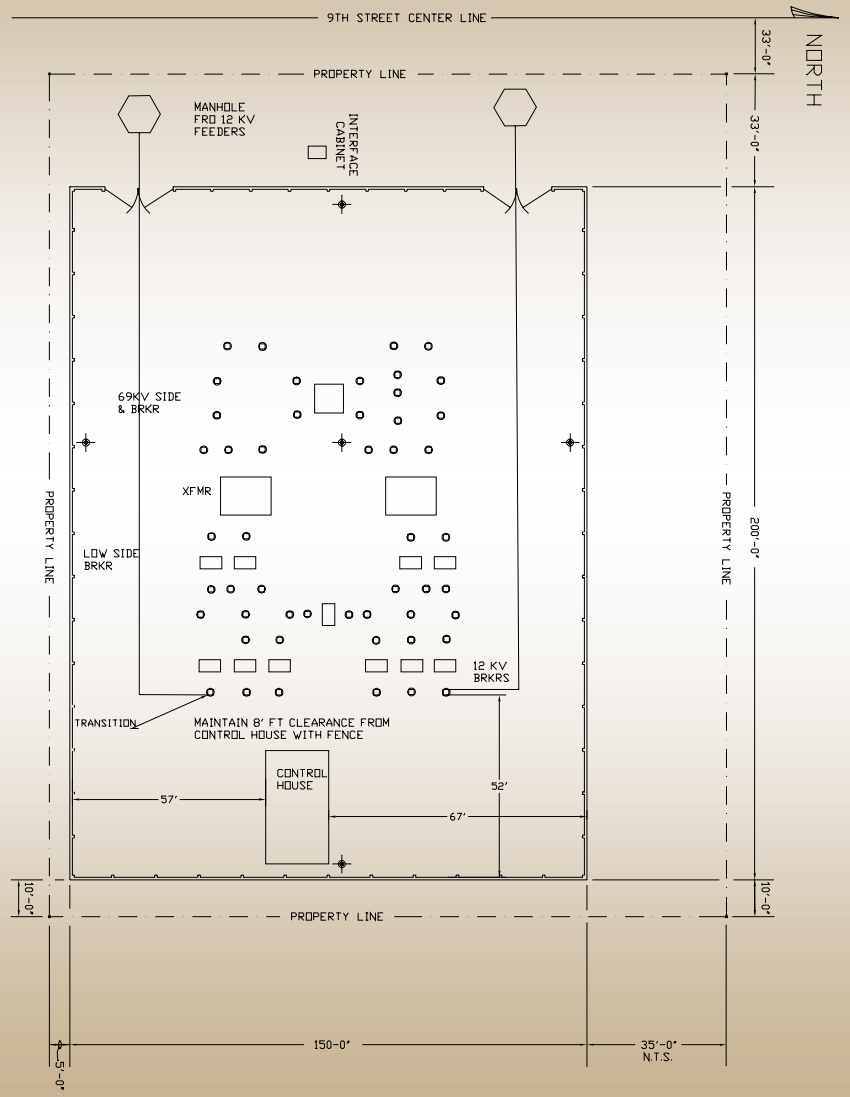


Implementation Overview

- Completion of project in shortest time a priority.
- Team effort essential.
  - Customer: STMicroelectronics
  - Utility: Arizona Public Service
  - UPS Supplier: S&C Electric Company
- Choose best location for ease of installation and schedule.
- All parties shared construction responsibility.
  - APS - Main feeders and civil construction
  - S&C - Equipment installation, power/control interconnection and testing
  - ST - Instrumentation/communication conduits to plant

Implementation Overview

Utility Substation Plan



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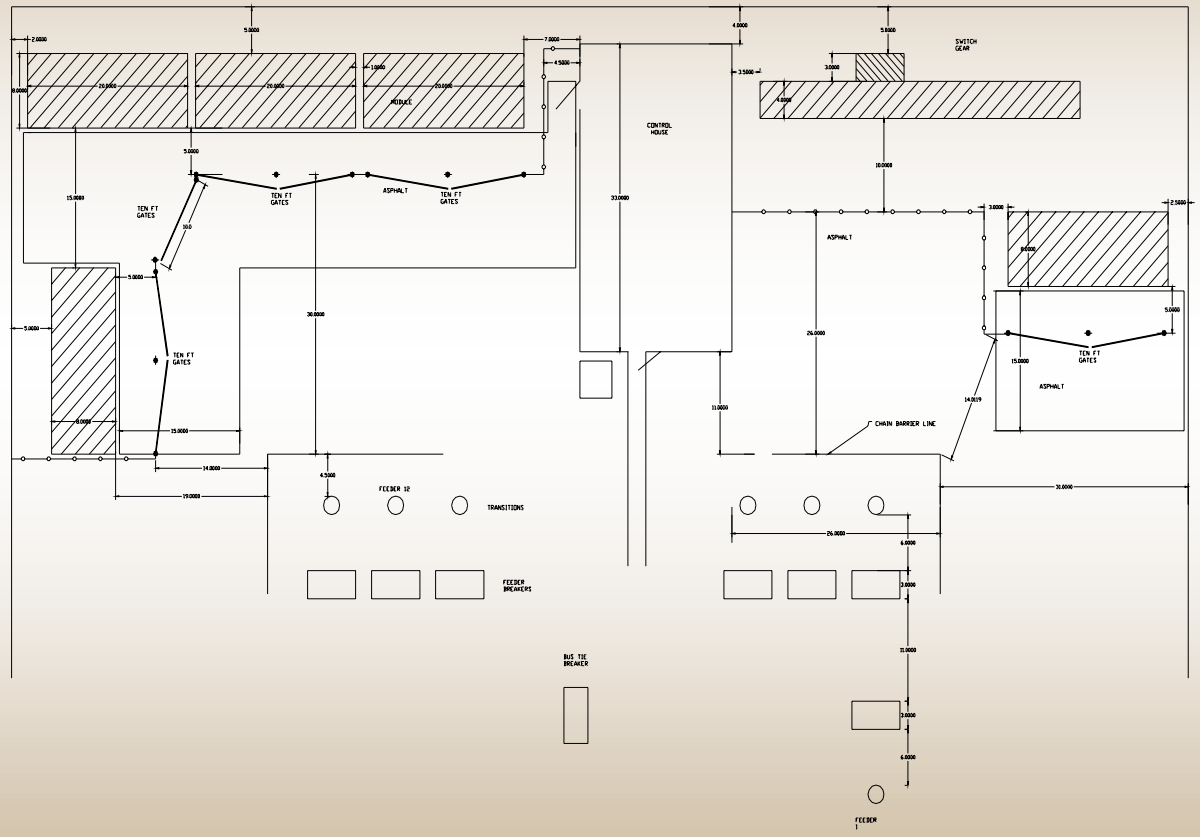
Implementation Overview

Implementation Overview

Substation Equipment Layout Plan



Implementation Overview

System Factory Testing

Implementation Overview

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Performance Results

- System placed in service August 17, 2000.
- First utility disturbance experienced on August 30, 2000.
- Total of 11 utility disturbances mitigated through March 2001.

Performance Results

System Operation/Utility Disturbances Log - STMicroelectronics				
DATE	**TIME HRS/MIN/SEC**	**DURATION SECONDS**	**CYCLES**	**COMMENT**
08/30/00	16:34:03	1.0	61	25% voltage sag
09/02/00	11:54:16	1.5	87	44% voltage sag
10/22/00	05:56:55	0.7	42	Not logged
12/09/00	06:24:31	0.7	43	16% voltage sag
12/27/00	00:26:04	0.6	38	15% voltage sag
01/12/01	04:07:25	0.6	33	14% voltage sag
02/02/01	16:36:31	1.6	93	36% voltage sag
02/02/01	16:55:27	0.7	39	Not logged
02/17/01	00:44:29	0.6	36	21% voltage sag
02/25/01	05:53:41	0.6	37	18% voltage sag
03/04/01	13:28:24	1.27	76	18% voltage sag